

## ANALYSIS OF MODEL TITAN ATMOSPHERIC COMPONENTS USING ION MOBILITY SPECTROMETRY

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A detailed knowledge of the history and abundances of the biogenic elements and their compounds throughout the solar system can provide exobiologists with a basis for understanding the conditions necessary for chemical evolution and the origin of life. Flight experiments conducting *in situ* analyses have already produced a wealth of information on the environments of Venus and Mars. Future missions will require instrumentation capable of providing identification and quantitation of a multitude of molecular species over a wide range of concentrations. As one of these future missions, NASA, in conjunction with the European Space Agency, plans to send a spacecraft to the Saturnian system (Cassini mission) to study Saturn and its satellite, Titan. An analysis of Titan's atmosphere presents a highly challenging task because of the complexity of the analysis, particularly in terms of the many species of organic carbon compounds that may be present, and the very low concentration levels that must be detected. The Gas Chromatograph - Ion Mobility Spectrometer (GC-IMS) has been proposed as an analytical technique for the analysis of Titan's atmosphere.

The Ion Mobility Spectrometer (IMS) is an atmospheric pressure, chemical detector that produces an identifying spectrum of each chemical species measured. When the IMS is combined with a Gas Chromatograph (GC) as a GC-IMS, the GC is used to separate the sample into its individual components, or perhaps small groups of components. The IMS is then used to detect, quantify, and identify each sample component. Conventional IMS detection and identification of sample components depends upon a source of energetic radiation, such as beta radiation, which ionizes the atmospheric pressure host gas. This primary ionization initiates a sequence of ion-molecule reactions leading to the formation of sufficiently energetic positive or negative ions, which in turn ionize most constituents in the sample. In conventional IMS, this reaction sequence is dominated by the water cluster ion. However, many of the light hydrocarbons expected in Titan's atmosphere cannot be analyzed by IMS using this mechanism at the concentrations expected. Research at NASA Ames and PCP Inc., has demonstrated IMS analysis of expected Titan atmospheric components, including saturated aliphatic hydrocarbons, using two alternate sample ionizations mechanisms. The sensitivity of the IMS to hydrocarbons such as propane and butane was increased by several orders of magnitude. Both ultra dry (waterless) IMS sample ionization and metastable ionization have successfully been used to analyze a model Titan atmospheric gas mixture.